# DATA SHEET

# TDA1516BQ
## 24 W BTL or 2 x 12 watt stereo car radio power amplifier

Product specification
File under Integrated Circuits, IC01

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Philips Semiconductors

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## GENERAL DESCRIPTION

The TDA 1516BQ is an integrated class-B output amplifier in a 13-lead single-in-line (SIL) plastic power package. The device is primarily developed for car radio applications.

## FEATURES

- Requires very few external components
- Flexibility in use – stereo as well as mono BTL
- High output power (without bootstrap)
- Low offset voltage at output (important for BTL)
- Fixed gain
- Good ripple rejection
- Mute/stand-by switch
- Load dump protection
- A.C. and d.c. short-circuit-safe to ground and $V_P$
- Thermally protected
- Reverse polarity safe
- Capability to handle high energy on outputs ($V_P$ = 0 V)
- No switch-on/switch-off plop
- Flexible leads
- Low thermal resistance
- Identical inputs (inverting and non-inverting)
- Compatible with TDA1518Q (except gain)

## QUICK REFERENCE DATA

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Supply voltage range | | | | | | |
| operating | | $V_P$ | 6,0 | 14,4 | 18,0 | V |
| non-operating | | $V_P$ | – | – | 30,0 | V |
| load dump protected | | $V_P$ | – | – | 45,0 | V |
| Repetitive peak output current | | $I_{ORM}$ | – | – | 4 | A |
| Total quiescent current | | $I_{tot}$ | – | 30 | – | mA |
| Stand-by current | | $I_{sb}$ | – | 0,1 | 100 | μA |
| Switch-on current | | $I_{sw}$ | – | – | 40 | μA |
| Input impedance | | | | | | |
| BTL | | $\|Z_I\|$ | 25 | – | – | kΩ |
| stereo | | $\|Z_I\|$ | 50 | – | – | kΩ |
| **Stereo application** | | | | | | |
| Output power | THD = 10%; 4 Ω | $P_o$ | – | 6 | – | W |
| | THD = 10%; 2 Ω | $P_o$ | – | 11 | – | W |
| Channel separation | | $\alpha$ | 40 | – | – | dB |
| Noise output voltage | | $V_{no(rms)}$ | – | 50 | – | μV |
| **BTL application** | | | | | | |
| Output power | THD = 10%; 4 Ω | $P_o$ | – | 22 | – | W |
| Supply voltage ripple rejection | $R_S$ = 0 Ω; f = 100 Hz to 10 kHz | RR | 48 | – | – | dB |
| D.C. output offset voltage | | $\|\Delta V_O\|$ | – | – | 100 | mV |

## PACKAGE OUTLINE

13-lead SIL-bent-to-DIL; plastic power (SOT141); SOT141-6; 1996 July 24.

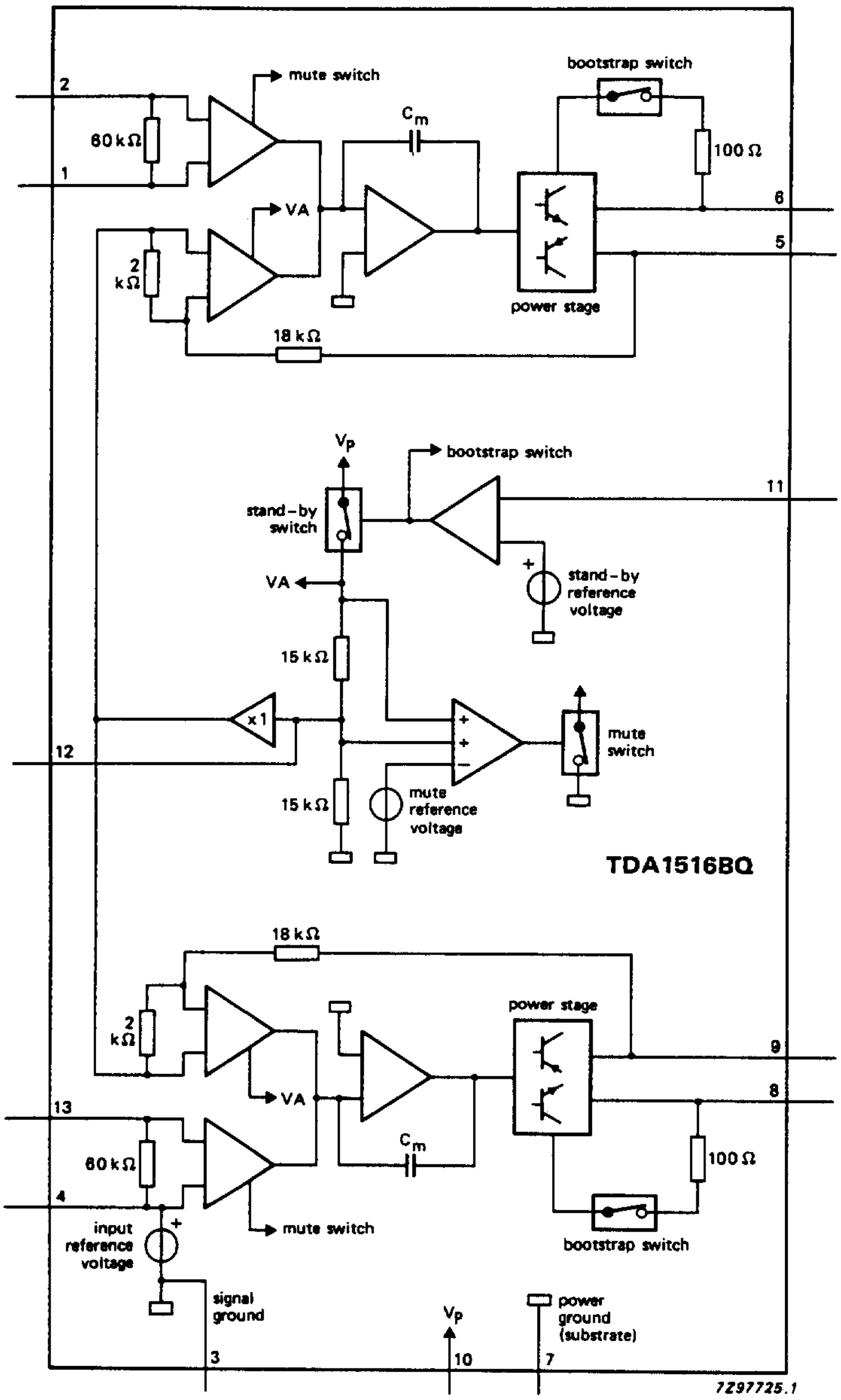



Fig.1 Block diagram.

## PINNING

| | | |
|---|---|---|
| 1 | –INV1 | non-inverting input 1 |
| 2 | INV | inverting input |
| 3 | GND1 | ground (signal) |
| 4 | $V_{ref}$ | reference voltage |
| 5 | OUT1 | output 1 |
| 6 | BS1 | bootstrap 1 |
| 7 | GND2 | ground (substrate) |
| 8 | BS2 | bootstrap 2 |
| 9 | OUT2 | output 2 |
| 10 | $V_P$ | supply voltage |
| 11 | M/SS | mute/stand-by switch |
| 12 | RR | supply voltage ripple rejection |
| 13 | –INV2 | non-inverting input 2 |

## FUNCTIONAL DESCRIPTION

The TDA1516BQ contains two identical amplifiers with differential input stages. This device can be used for stereo or bridge applications. The gain of each amplifier is fixed at 20 dB. A special feature of this device is the mute/stand-by switch which has the following features:

- low stand-by current (< 100 μA)
- low mute/stand-by switching current (low cost supply switch)
- mute condition.

## RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| PARAMETER | CONDITIONS | SYMBOL | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| Supply voltage | | | | | |
| operating | | $V_P$ | – | 18 | V |
| non-operating | | $V_P$ | – | 30 | V |
| load dump protected | during 50 ms; $t_r \geq 2{,}5$ ms | $V_P$ | – | 45 | V |
| A.C. and d.c. short-circuit-safe voltage | | $V_{PSC}$ | – | 18 | V |
| Reverse polarity | | $V_{PR}$ | – | 6 | V |
| Energy handling capability at outputs | $V_P = 0$ V | | – | 200 | mJ |
| Non-repetitive peak output current | | $I_{OSM}$ | – | 6 | A |
| Repetitive peak output current | | $I_{ORM}$ | – | 4 | A |
| Total power dissipation | see Fig.2 | $P_{tot}$ | – | 25 | W |
| Crystal temperature | | $T_c$ | – | 150 | °C |
| Storage temperature range | | $T_{stg}$ | –55 | + 150 | °C |

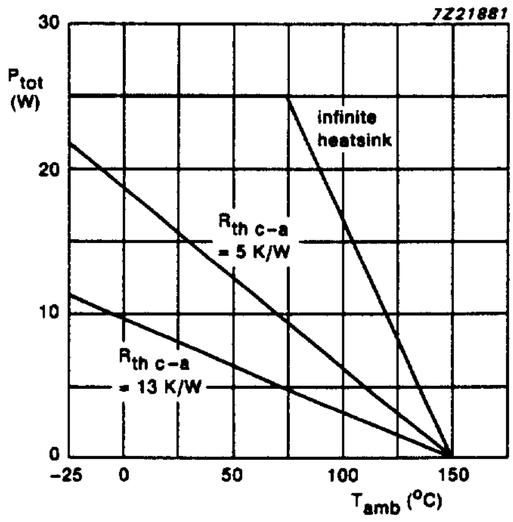



Fig.2 Power derating curve.

**D.C. CHARACTERISTICS (note 1)**

$V_P$ = 14,4 V; $T_{amb}$ = 25 °C; unless otherwise specified

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **Supply** | | | | | | |
| Supply voltage range | note 2 | $V_P$ | 6,0 | 14,4 | 18,0 | V |
| Quiescent current | | $I_P$ | – | 40 | 80 | mA |
| D.C. output voltage at approximately $V_P/2$ | note 3 | $V_O$ | – | 6,8 | – | V |
| D.C. output offset voltage | | $\|\Delta V_{5-9}\|$ | – | – | 100 | mV |
| **Mute/stand-by switch** | | | | | | |
| Switch-on voltage level | | $V_{ON}$ | 8,5 | – | – | V |
| **Mute condition** | | $V_{mute}$ | 3,0 | – | 6,4 | V |
| Output signal in mute position | $V_I$ = 1 V (max.); f = 20 Hz to 15 kHz | $V_O$ | – | – | 2 | mV |
| D.C. output offset voltage | | $\|\Delta V_{5-9}\|$ | – | – | 100 | mV |
| **Stand-by condition** | | $V_{sb}$ | 0 | – | 2 | V |
| D.C. current in stand-by condition | | $I_{sb}$ | – | – | 100 | µA |
| Switch-on current | | $I_{sw}$ | – | 12 | 40 | µA |

**A.C. CHARACTERISTICS**

$V_P$ = 14,4 V; $R_L$ = 4 Ω; f = 1 kHz; $T_{amb}$ = 25 °C; unless otherwise specified

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **Stereo application** | note 1 | | | | | |
| Output power | note 4; | | | | | |
| | THD = 0,5% | $P_o$ | 4 | 5 | – | W |
| | THD = 10% | $P_o$ | 5,5 | 6,0 | – | W |
| | notes 4 and 5; | | | | | |
| | THD = 10% | $P_o$ | 6 | 7 | – | W |
| Output power at | note 4; | | | | | |
| $R_L$ = 2 Ω | THD = 0,5% | $P_o$ | 7.5 | 8,5 | – | W |
| | THD = 10% | $P_o$ | 10 | 11 | – | W |
| | notes 4 and 5; | | | | | |
| | THD = 10% | $P_o$ | 10,5 | 12,0 | – | W |
| Low frequency roll-off | note 6; | | | | | |
| | –3 dB | $f_L$ | – | 45 | – | Hz |
| High frequency roll-off | –1 dB | $f_H$ | 20 | – | – | kHz |
| Closed loop voltage gain | | $G_v$ | 19 | 20 | 21 | dB |
| Supply voltage ripple | | | | | | |
| rejection: | note 7 | | | | | |
| ON | | RR | 48 | – | – | dB |
| mute | | RR | 48 | – | – | dB |
| stand-by | | RR | 80 | – | – | dB |
| Input impedance | | $\|Z_I\|$ | 50 | 60 | 75 | kΩ |
| Noise output voltage: | note 8; | | | | | |
| ON | $R_S$ = 0 Ω | $V_{no(rms)}$ | – | 50 | – | μV |
| ON | $R_S$ = 10 kΩ | $V_{no(rms)}$ | – | 70 | 100 | μV |
| mute | note 9 | $V_{no(rms)}$ | – | 50 | – | μV |
| Channel separation | $R_S$ = 10 kΩ | α | 40 | – | – | dB |
| Channel balance | | $G_v$ | – | – | 1 | dB |

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **BTL application** | note 10 | | | | | |
| Output power | THD = 0,5% | $P_o$ | 15,5 | 17,0 | – | W |
| | THD = 10% | $P_o$ | 20 | 22 | – | W |
| | note 5; THD = 10% | $P_o$ | 21 | 24 | – | W |
| Output power at $V_P$ | | | | | | |
| = 13,2 V | THD = 0,5% | $P_o$ | – | 13,5 | – | W |
| | THD = 10% | $P_o$ | – | 17 | – | W |
| | note 5; THD = 10% | $P_o$ | – | 19 | – | W |
| Power bandwidth | THD = 0,5% | | | | | |
| | $P_o$ = 15 W | $B_w$ | – | 20 to 15 000 | – | Hz |
| Low frequency roll-off | note 6; | | | | | |
| | –3 dB | $f_L$ | – | 25 | – | Hz |
| High frequency roll-off | –1 dB | $f_H$ | 20 | – | – | kHz |
| Closed loop voltage gain | | $G_v$ | 25 | 26 | 27 | dB |
| Supply voltage ripple | | | | | | |
| rejection: | note 7 | | | | | |
| ON | | RR | 48 | – | – | dB |
| mute | | RR | 48 | – | – | dB |
| stand-by | | RR | 80 | – | – | dB |
| Input impedance | | $\|Z_I\|$ | 25 | 30 | 38 | kΩ |
| Noise output voltage | note 8; | | | | | |
| ON | $R_S$ = 0 Ω | $V_{no(rms)}$ | – | 70 | – | μV |
| ON | $R_S$ = 10 kΩ | $V_{no(rms)}$ | – | 100 | 200 | μV |
| mute | note 9 | $V_{no(rms)}$ | – | 60 | – | μV |

**Notes to the characteristics**

1. All characteristics, for stereo application are measured using the circuit shown in Fig.3.
2. The circuit is d.c. adjusted at $V_P$ = 6 V to 18 V and a.c. operating at $V_P$ = 8,5 to 18 V.
3. At 18 V < $V_P$ < 30 V the d.c. output voltage ≤ $V_P/2$.
4. Output power is measured directly at the output pins of the IC.
5. With bootstrap and a 100 kΩ resistor from pin 12 to the positive supply voltage ($V_P$), value of bootstrap capacitor is 47 μF.
6. Frequency response externally fixed.
7. Ripple rejection measured at the output with a source impedance of 0 Ω (maximum ripple amplitude of 2 V) and a frequency between 1 kHz and 10 kHz.
8. Noise voltage measured in a bandwidth of 20 Hz to 20 kHz.
9. Noise output voltage independent of $R_S$ ($V_I$ = 0 V).
10. All characteristics, for BTL application are measured using the circuit shown in Fig.4.

## APPLICATION INFORMATION

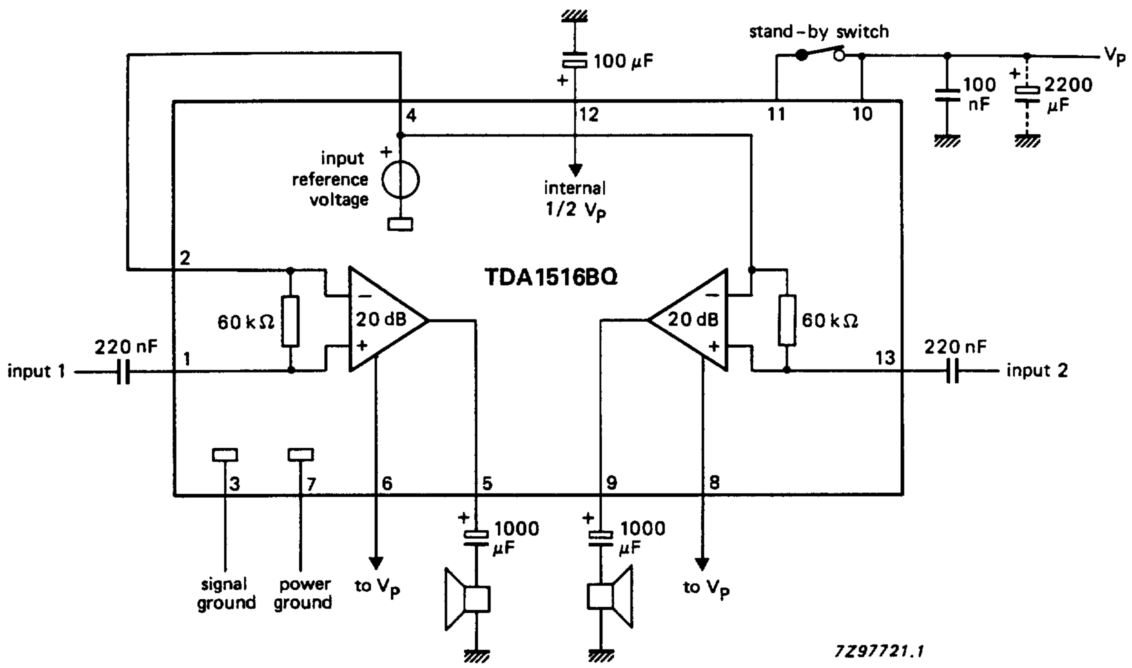



Fig.3 Stereo application circuit diagram.

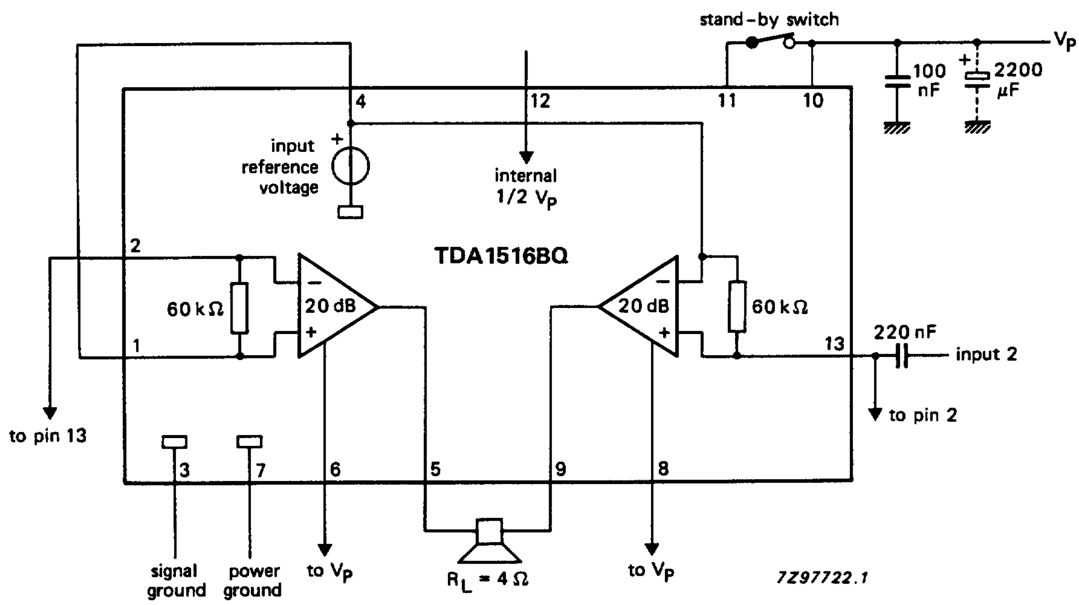
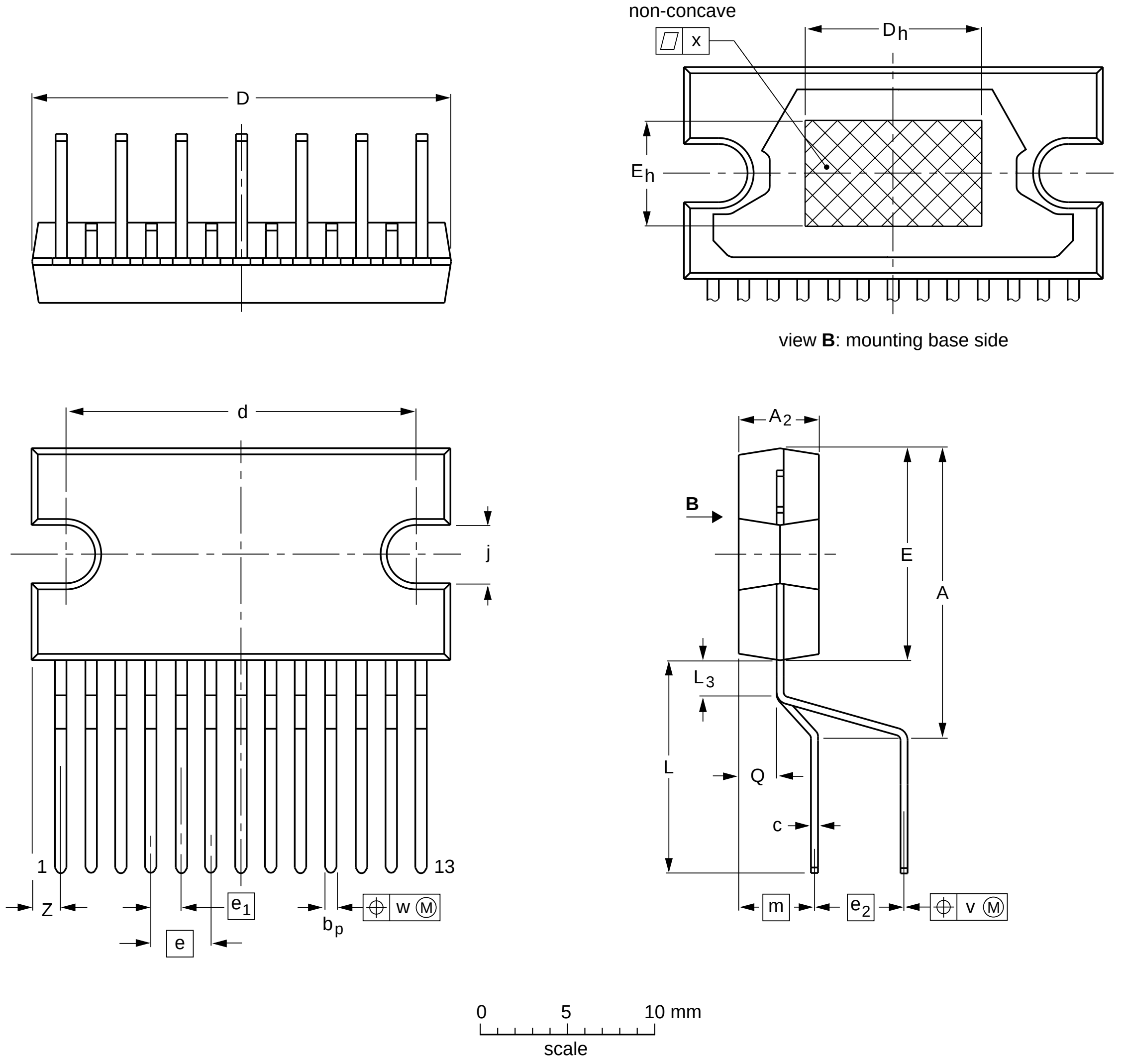



Fig.4 BTL application circuit diagram (without bootstrapping).

## PACKAGE OUTLINE

**DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm) SOT141-6**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_2$ | $b_p$ | c | D(1) | d | $D_h$ | E(1) | e | $e_1$ | $e_2$ | $E_h$ | j | L | $L_3$ | m | Q | v | w | x | Z(1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 17.0<br>15.5 | 4.6<br>4.2 | 0.75<br>0.60 | 0.48<br>0.38 | 24.0<br>23.6 | 20.0<br>19.6 | 10 | 12.2<br>11.8 | 3.4 | 1.7 | 5.08 | 6 | 3.4<br>3.1 | 12.4<br>11.0 | 2.4<br>1.6 | 4.3 | 2.1<br>1.8 | 0.8 | 0.25 | 0.03 | 2.00<br>1.45 |

**Note**

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT141-6 | | | | | | ~~92-11-17~~<br>95-03-11 |

## SOLDERING

### Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

### Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

### Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

## DEFINITIONS

| **Data sheet status** | |
|---|---|
| Objective specification | This data sheet contains target or goal specifications for product development. |
| Preliminary specification | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification | This data sheet contains final product specifications. |
| **Limiting values** | |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

## LIFE SUPPORT APPLICATIONS

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